7. BIOLOGICAL IMPLICATIONS
(By DNR)

7.0 BIOLOGICAL EFFECTS EVALUATION

7.1 Introduction

The last significant effort in this feasibility study was to determine the effect of the varying reef alignments on selected marine species. The alternative reef alignment's effect on salinity levels and other water quality parameters had been previously determined during the modeling program of this study. As spotted seatrout (locally named speckled trout) are very popular among recreational anglers along the entire Gulf Coast, this species was selected for evaluation. Additionally white and brown shrimp were evaluated. The mechanism to assess the reef's effect on spotted seatrout and shrimp populations were the habitat suitability index (HSI) models for these species developed by the U.S. Fish and Wildlife Service.

7.2 Biological Implications for Potential Salinity Alterations

The habitat suitability index values of spotted seatrout (*Cynoscion nebulosus*), white shrimp (*Penaeus setiferus*), and brown shrimp (*P. aztecus*) were examined for the alternative reef alignments, based on the salinity shifts predicted by the hydrologic model. These models examine environmental factors that influence the distribution of the modeled species, and converts these factors into a HSI between 0 (unsuitable) and 1 (optimally suitable).

The HSI for spotted seatrout considers factors that affect the survival of the egg, larval, and juvenile life stages, because these stages are the most sensitive to environmental factors and their survival is assumed to most influence adult abundances (Kostecki 1984). Based on generalized habitat requirements, this model is designed to be applied to estuarine environments along the Atlantic and Gulf of Mexico coasts of the United States.

The seatrout model assumes that the primary factors determining habitat quality are a water quality factor (temperature and salinity) and a food and cover factor (percentage of the area with submerged and emergent vegetation, submerged islands, shell reefs, and oyster beds). The model has a total of five components (two for salinity, two for temperature, and one for cover). For spotted seatrout, salinities between 19 ppt and 38 ppt are considered optimal, and salinities above 45 ppt and below 5 ppt are unsuitable. The salinity factor also has a temporal component, and includes terms for the lowest monthly mean winter-spring (December-May) salinity (V_1), and the highest monthly mean summer (June-September) salinity (V_2). The salinity component is the arithmetic mean of these two factors: $(SI_{V1} \times SI_{V2})^{1/2}$.

The final suitability is determined by comparing the two main factors (water quality and food/cover). The water quality component is the lower of the salinity and temperature suitabilities. The final suitability is the lower of the water quality component and the food and cover component. For the purposes of this investigation, temperature and the food and cover factors were not expected to vary significantly as a result of the reef construction, and were assumed to be non-limiting, because the purpose of this exercise was to identify the potential influence of the predicted changes in salinity identified by the hydrodynamic model. This approach maximizes the ability to detect the influence of salinity changes. In actuality, however, the food and cover factor would probably be limiting as well. The optimal cover is 50 percent or more (HSI = 1.0), but the actual cover is probably less than 10 percent, which would have a suitability of only 0.2.

The mean monthly salinities were obtained from the model at the output station locations for the reef alignments and the no-action alternative, and V_1 and V_2 were identified. The salinity suitability was then calculated, and the alternatives were compared to the no-action alternative. In most locations, no change in suitability was indicated (salinity shifts were too small to influence the suitability, or salinities were still below 5 ppt).

While no increases in habitat suitability for spotted seatrout were noted for the A1, B1 or B2 alternatives, some shifts were predicted for the A2 alternative (Table 1). In three sampling stations (SW Pass – Outer, West Entrance of Atchafalaya Bay, and Marsh Island – Gulf of Mexico), the HSI increased. The greatest increase was noted for SW Pass – Outer, where the HSI increased 0.22, which means that the factors were 22 percent more suitable for spotted seatrout. Salinity shifts predicted by the other reef alignments examined would produce a similar, although smaller, shift in suitability patterns. More interesting were the results of the comparison with historic conditions. An increase in HSI was noted at every sampling station, with increases from 0.04 to 1.00 (Table 2). Whereas the average HSI increased 0.03 for A2, it increased 0.64 for the historic conditions. This means that historically, the Acadiana Bays system was much more suitable for spotted seatrout, which reflects anecdotal evidence. At these salinities, however, other environmental factors (e.g., percent cover) would likely become the limiting component, and the full increase in suitability would not be realized. Unfortunately, it also supports the premise that changes to the reef systems in the Acadiana Bays system would not appreciably increase the suitability for spotted seatrout.

Table 1. Change in HSI predicted by the construction of Alternative A2 (225-degree reef at mean water level). HSI ranges from 0 (unsuitable) to 1 (optimal), so differences indicate an increase in suitability.

Station	HSI Difference		Station	HSI Difference
Pt. Chevreuil	0.00		West Cote Bay	0.00
SW Pass (outer)	0.22		East Cote Bay	0.00
SW Pass (inner)	0.00		Reefs	0.00
Vermillion Bay	0.00		Atchafalaya Bay	0.00
L. Vermilion	0.00		W. Ent. Atch. Bay	0.11
W. Vermilion	0.00		E. Ent. Atch. Bay	0.00
Weeks Bay	0.00		Four League Bay	0.00
Vermilion-W. Cote	0.00		Marsh Island GoM	0.13

Table 2. Difference in HSI of historic conditions (pre-GIWW and Wax Lake Outlet) compared to present conditions. HSI ranges from 0 (unsuitable) to 1 (optimal), so differences indicate an increase in suitability.

Station	HSI Difference		Station	HSI Difference
Pt. Chevreuil	NP*		West Cote Bay	0.79
SW Pass (outer)	1.00		East Cote Bay	0.75
SW Pass (inner)	1.00		Reefs	NP
Vermillion Bay	0.82		Atchafalaya Bay	0.04
L. Vermilion	0.11		W. Ent. Atch. Bay	1.00
W. Vermilion	0.75		E. Ent. Atch. Bay	0.68
Weeks Bay	0.75		Four League Bay	NP
Vermilion-W. Cote	0.79		Marsh Island GoM	0.61

* NP – Salinity output for this station was not predicted for historic conditions.

For brown and white shrimp, the substrate type is much more important than salinities in the range observed in the Acadiana Bays system (Turner and Brody 1983). At 10 percent cover, the HSI is only 0.10. Where cover is greater the substrate composition also becomes important, but because the cover factor is weighted twice as great as substrate, the effect is minimized. The food and cover component is calculated as: $(SI^2_{V1} \times SI_{V2})^{1/3}$, where V1 is the percentage of the estuary covered by submerged vegetation, and V2 is the substrate composition (soft mud, sandy mud, or hard bottom). Since submerged vegetation in the Acadiana Bays system is likely limited by light penetration, and even a reduction in turbidity wouldn't increase the total area covered by this vegetation beyond 10 percent, an increase in suitability would not be expected. In fact, the model predicts substantial reductions in turbidity at only three locations, around East and West Cote Blanche bays, and these reductions are all less than 50 percent. As such, changes in salinity or turbidity on the order of magnitude predicted by the hydrodynamic model would have no significant effect on suitability for white or brown shrimp.

In a gillnet survey of fishes in the Vermilion and Cote Blanche Bays (Baltz et al. 2000a), the relative abundances of spotted seatrout, among other fishes, was examined. Of a total 5,930 fishes collected, 224 (3.8 percent) spotted seatrout were collected in 51 (28.0 percent) of the 182 gillnet samples. They were collected at a mean salinity of 5.0 ppt for fish less than 300 mm total length, and 4.5 ppt for fish larger than 300 mm (4.7 ppt overall). Adults prefer salinities from 20 to 35 ppt (Kostecki 1984)..

Baltz et al. (2000b) predict that the current salinity regime of the Vermilion Bay area is marginal for spotted seatrout. Management strategies that increase salinities would likely lead to increases in spotted seatrout populations, as catch per unit effort (CPUE) increased with increasing salinities observed in the Vermilion Bay area. Nevertheless, increases of more than 5 ppt would be required to expect significant increases in spotted seatrout abundances.

In summary, the historical conditions hydrodynamic model indicated salinities in the range of much greater suitability for spotted seatrout than the existing conditions hydrodynamic model. The five reef alternatives proposed did not increase salinities greatly enough to significantly increase spotted seatrout suitability. Based on the habitat suitability indices and empirical data from gillnet surveys of the Vermilion Bay area, changes in salinities predicted by the model would have little or no effect on the availability of spotted seatrout, brown shrimp, or white shrimp.

7.3 References

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